
TRENDS IN STUDENT ACHIEVEMENT IN PORTUGAL

What does PISA tell us?

Luís Catela Nunes
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EDULOG
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Trends in student achievement in Portugal: What does PISA tell us?

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EXECUTIVE SUMMARY

- This study analyses the evolution of student achievement in Portugal over the last two decades.
- The approach is quantitative and based on student-level data from OECD's PISA triennial studies of 15-year-old students abilities in reading, math, and science.
- PISA provides a global benchmark for educational performance and has been used to inform educational policies worldwide. The latest study, in 2022, included 81 participating countries.
- Portugal has been participating in PISA since its first edition in 2000, when the country achieved some of the worst results among the 43 surveyed countries. In math, performance only surpassed Brazil and Mexico. It trailed behind nations with lower levels of spending per student, such as Hungary, Poland, the Czech Republic, and Ireland.
- In 2015, Portugal reached the OECD average and was considered a success case in Europe.
- The analysis of the PISA data also allows a better understanding of inequalities and various educational gaps.
- Gender gaps: Girls do better in reading than boys do, but the gap has narrowed from 2015 onward. Boys do better in math. There isn't much of a difference in science between boys and girls.
- Vocational vs. academic track: The different PISA cycles depict a large increase in the proportion of 15-year-old students enrolled in vocational courses. This growth is particularly strong in private schools where the percentage of students pursuing a vocational track rose from less than 20% in 2012 and 2015 to more than 50% since 2018. Students with more educated parents are less likely to choose the vocational track. Additionally, it appears to be more appealing to students who perform poorly.
- Private vs. public schools: The performance gap between private and public schools shifted significantly over time because of significant adjustments in vocational courses. However, in the academic track, private schools outperform public schools, even among students whose parents are more educated, implying that other factors are at play.
- Socioeconomic gaps: The performance gaps between students from the highest and lowest socioeconomic backgrounds have remained relatively stable over time. Still, students from lower socioeconomic backgrounds perform better in Portugal than students from similar

backgrounds in other countries. However, compared to other OECD countries, Portugal has a disproportionate large proportion of least advantaged students (those in the bottom decile of the distribution of the economic, social and cultural status across OECD countries): the percentage is 13% in Portugal, and is only surpassed by Turkey (39%) and Mexico (32%).

- **Parental education:** In 2003, the overall level of parental education among 15-year-old students in Portugal was relatively low. More than half of the students had parents who had not completed secondary education, and less than 20% had at least one parent with a bachelor's degree. By 2022, 45% of the students already had at least one parent with a bachelor's degree.

- **Parental education and the evolution of PISA scores:** The initial improvement in scores in all PISA domains until the mid-2000s was driven by increases in student performance across all parental education levels. Since 2015, the substantial improvement in the level of parental education of 15-year-old students in Portugal has contributed to maintain the overall PISA results aligned with the OECD average.

- In 2015, the average performance of students whose parents have a university degree begins to decline. For the other students, the downward trend begins in 2018. The continued improvement in the parents' qualifications counteracted that downward trend and helped maintain the increase in the Mathematics PISA scores until 2018. In Reading and Science, the average PISA scores fell in 2018 as the improvement in the parents qualifications was not strong enough to compensate for the downward trend in performance.

- In PISA 2022, the first results published after the pandemic which was responsible for prolonged school closures, Portugal's average scores fell more than the OECD average and dropped below 2009 levels across the three main domains. The continued improvement in the parents qualifications likely helped to prevent an even larger drop in the average PISA scores.

- **Socioeconomic status:** Between 2018 and 2022, the change in results differed by socioeconomic groups. The best performers among the most advantaged students did not see a decline in performance, but the best performers among the least advantaged did.

- **Top and low performers:** The gap between top and low performers decreased, mainly due to the drop in results by top performers. There are less than 1% top performers among the least advantaged students in 2022, compared to 57% low performers. Amongst the most advantaged, 24% are top performers and 7% low performers.

- The outlook for the near future, and for the results of Portugal in PISA 2025, is very uncertain. The higher qualifications of the parents of the new 15-year-old cohort will likely be a positive

factor. However, there is a large amount of uncertainty and lack of information about the extent to which learning losses in Portugal are being recovered or not.

- It is thus important to improve the current national framework of standardized testing and regular student assessment to monitor the education system and to be able to act quickly.
- Also, evidence-based policies are fundamental to distinguish between effective and non-effective education programs.

INTRODUCTION

International Large-Scale Assessments (ILSA) have emerged as an essential tool for tracking how students' learning has changed over time in various educational systems. The Programme for International Student Assessment, also known as PISA, an international study conducted by the Organisation for Economic Cooperation and Development (OECD), is one of the most well-known ILSAs, serving as one of the primary data sources for comparing student performance across participating countries. It assesses 15-year-old students' ability to apply Reading, Mathematics, and Science knowledge to real-world challenges and provides a global benchmark for educational performance and problem-solving skills. It helps identify areas for improvement and inform educational policies worldwide.

The PISA assessment takes place every 3 years, except for the latest survey which was delayed by one year due to the COVID-19 pandemic. The first PISA took place in 2000, with approximately 265,000 participating students representing 43 countries. In the latest PISA assessment, in 2022, around 690,000 students participated representing about 29 million 15-year-olds from schools in 81 participating countries and economies. This included 37 OECD member countries and 44 non-OECD countries and economies from various regions around the world.

The analysis of the first PISA assessment in 2000 revealed an important result, and for many a surprising one: a low correlation between average student performance and how much countries spend on educational institutions. For instance, Korea, one of the top performing countries, performed better than countries with more than twice the expenditure in education per student like the United States, Switzerland, or Austria (see OECD, 2001). The results raised a global awareness of the striking differences between countries and challenged many education systems around the world to rethink their education policies and to look at what more successful countries were doing.

In addition to covering students' performance on the three domains, PISA also provides a wealth of data on the characteristics of students, schools, and parents. This rich set of information makes it a widely used database for education research. The PISA datasets have been used to address a plethora of relevant education policy questions, such as the drivers of inequality in student performance (Woessmann, 2016), the effect of the changes in instruction time on students' results (Lavy, 2015), how different external assessment methods across countries explain differences in outcomes (Bergbauer et al., 2022), the size of peer effects (Vandenberghe & Robin, 2004), the potential benefits of larger school autonomy (Hanushek et al., 2013), or how the results in PISA tests correlate with economic growth (Hanushek et al., 2017). Cordero et al. (2018) recently conducted a review of the literature that makes use of PISA and other ILSA data to infer about the causal effects of educational policies. The setting up of PISA samples and their representativeness of the actual 15-year-old population have also been investigated. Jerrim (2013) and Anders et al. (2020) examine the representativeness of the British PISA samples, while Durrant and Schnepf (2018) elaborate on student exclusion criteria from the PISA samples in Sweden. O'Leary (2001) compares age-based sampling tests, which is the case of PISA, with grade-based ones, such as

TIMSS - Trends in International Mathematics and Science Study. Because of the broad range of areas covered by PISA data, each new publication of PISA results is met with intense policy and media attention (e.g., Hopfenbeck & Görger, 2017).

The Portuguese participation in PISA has resulted in an increased awareness of student performance and alignment of the Portuguese system with international standards (e.g., Crato, 2020, and Marôco, 2020a). Marôco & Lourenço (2017) show that PISA results are a good proxy for students' learning, comparing PISA results to those in external standardised examinations administered at the central level. Marôco (2020b) explores how recent educational policy changes relate to the evolution of PISA scores in Portugal. Regarding the Portuguese PISA data, Freitas et al. (2016) elaborate on the representativeness of the sample, highlighting relevant sampling issues for specific sub-groups of students in PISA 2006 and 2009. Carneiro (2008) examines the sources of inequality in educational achievement in Portugal using PISA 2000, concluding that most of the variance of school achievement is explained by family characteristics, while observed school inputs explain very little. Pereira (2011) decomposes the main drivers behind the evolution in Portuguese PISA results up to 2009, filtering the change in results from the demographic changes in the country. More recently, Reis et al. (2024), analyse the evolution of scores in Mathematics, with a focus on PISA 2022, drawing comparisons with other eurozone countries.

After two decades of international student assessments carried out by the OECD, Portugal has been considered a success story in Europe. It started, in 2000, as one of the worst performing countries. In Mathematics, performance was similar to Greece and Luxembourg, and only surpassed Brazil and Mexico. It lagged behind countries like Ireland, the Czech Republic, Poland or Hungary, all of which had lower levels of expenditures per student. Soon after, in 2015, Portugal surpassed the OECD average, maintaining its relative position in 2018.

In December 2023, the OECD released the results of PISA 2022 (OECD, 2023). The timing of this study is especially important. It was one of the first comprehensive assessments of students in Portugal since the COVID pandemic. In all three domains, the mean scores fell below the OECD average and were even lower than the levels in 2009. The results also provided an understanding of whether the student recovery programmes that were put in place by the Portuguese government were effective or not.

In this study, we provide a characterization and understanding of the drivers behind the evolution of student achievement in Portugal until 2022. Our approach is quantitative and based on student-level data collected in each of the PISA cycles. Since PISA results are based on representative samples of the 15-year-old student population in each country, we make use of PISA's reported final sampling weights to extrapolate our results to the population (for details about the sampling methods used in PISA, see e.g. OECD, 2024). We start our analysis with PISA 2003, instead of 2000, to ensure data comparability over time (for instance, the first full assessment in Mathematics took place only in PISA 2003).

We address questions such as: How much of the evolution can be explained by the Portuguese Education System? Or, could the observed evolution be a consequence of the

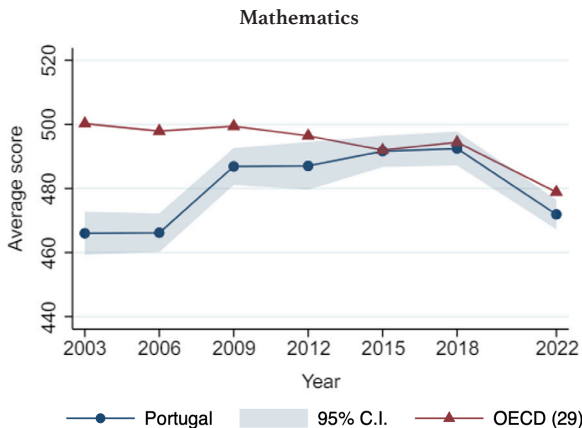
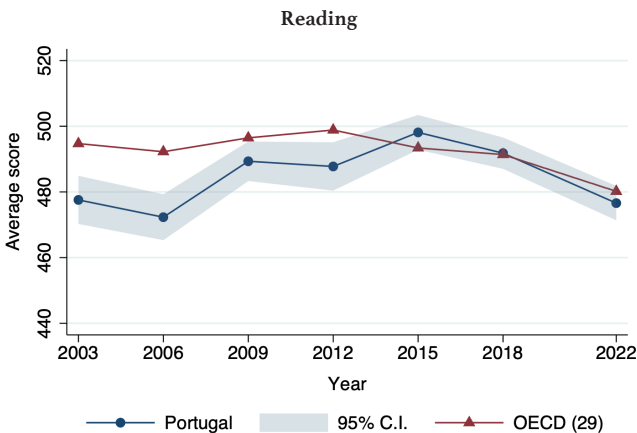
improved qualifications of the students' parents? We look at the long-term trajectories of performance in Reading, Mathematics, and Science and how Portugal compares to other countries. We analyse the trends and check whether the improvements were steady over time.

We also look at gaps and equity in education and address several relevant questions such as: Did all students have equal opportunities to learn over time? Are there fewer low performers? And more top performers? How are achievement gaps between top and bottom performers evolving? How has the gender gap among students changed over time? How large are the gaps in terms of the students' socioeconomic status (SES)? Are low-SES students improving their achievement over time? Is the gap between low- and high-SES students closing? Are there gaps between students in different educational tracks? Are these gaps different between public and private schools? How does Portugal compare to other countries in terms of inequalities and educational opportunities?

Finally, we look at the impact of the pandemic in Portugal and provide an outlook for the future.

PORTUGAL IN PISA: TRENDS IN PERFORMANCE

The figure below shows the evolution of the mean scores for Portugal in each of the three main domains assessed by PISA: Reading, Mathematics, and Science. The figures additionally report the corresponding 95% confidence intervals for the mean scores in the whole population (represented by the shaded areas), as PISA is applied to a representative sample of the population of 15-year-old students. The figures also show the evolution of the OECD average. In order to keep this comparison group stable over time, the OECD average includes 29 countries which, like Portugal, have been OECD members and participated in every PISA cycle since 2003. These are: Australia, Austria, Belgium, Canada, Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Ireland, Iceland, Italy, Japan, Mexico, Netherlands, Norway, New Zealand, Poland, Portugal, Slovakia, South Korea, Spain, Sweden, Switzerland, Turkey, United Kingdom, and the United States of America.



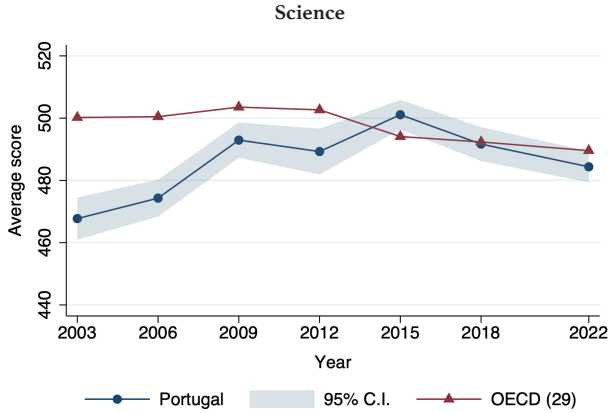
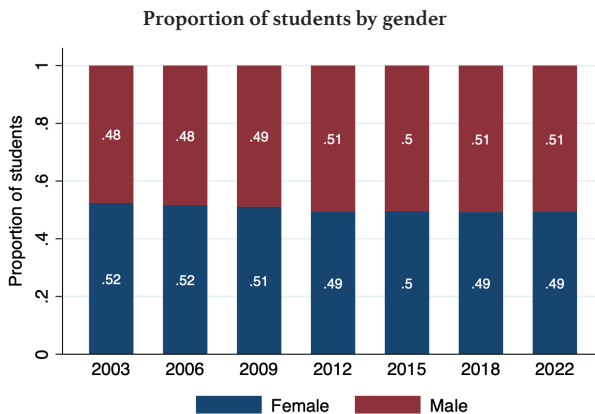


Figure Evolution of the mean scores over time

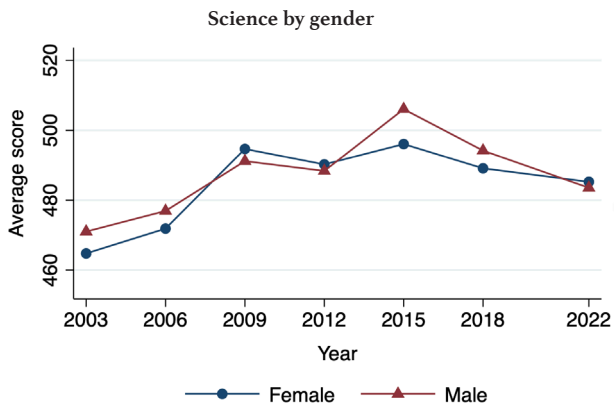
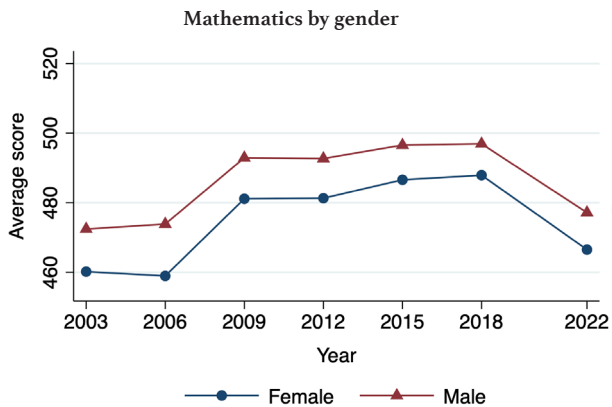
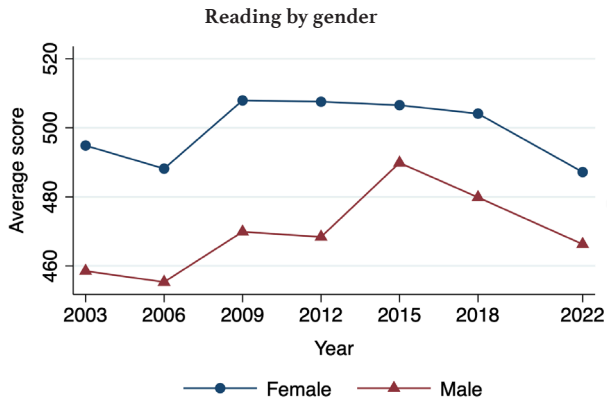
Starting in 2000 as one of the worst performing countries, Portugal surpassed the OECD average in 2015. This happened in all three main domains assessed by PISA: Reading, Mathematics, and Science. The biggest jump in performance was from 2006 to 2009. In 2018, Portugal consolidated its position. In 2022, mean scores decreased substantially, and fell below the 2009 levels in all domains. The declines were slightly more pronounced than what happened for the average of other OECD countries. Compared to the average of other OECD countries, the decreases were more pronounced.

Gender gaps

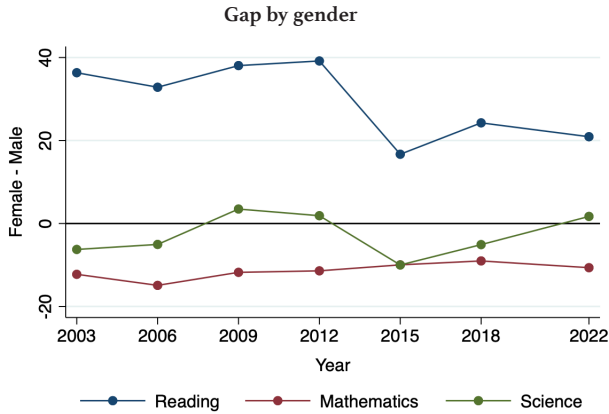
The proportion of 15-year-old boys and girls over time is relatively constant, with about half of each, as shown in the figure below.



However, there are noticeable differences when it comes to comparing their performance. The figures below show how the mean scores for boys and girls in each domain evolved over time.

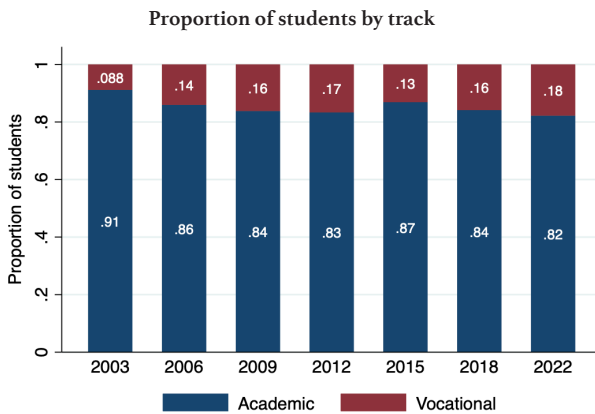


The gaps between boys' and girls' average scores is depicted in the figures below. In Reading, girls have consistently outperformed boys, but the gap has narrowed from 2015 onward. In Mathematics, boys have consistently outperformed girls. This gap is smaller in absolute value than the Reading gap, and is relatively constant over time. In Science, there is little disparity between boys and girls.



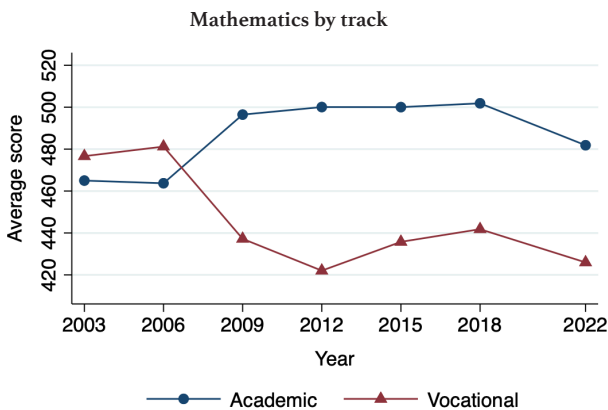
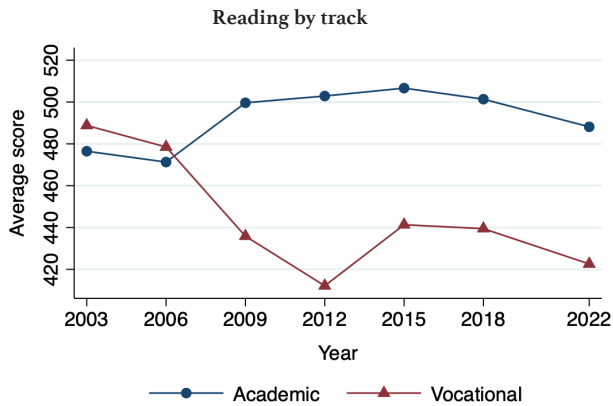
Tracks: Academic and vocational

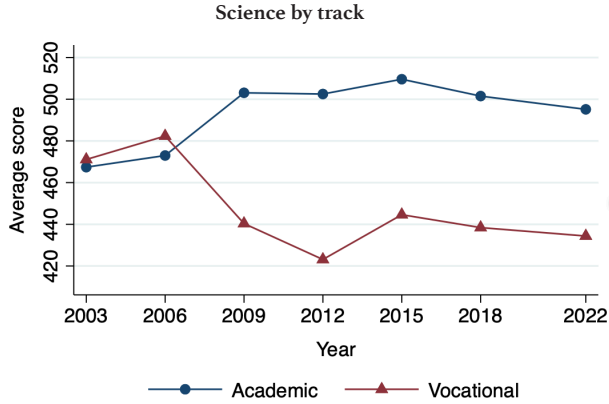
In 2022, 18% of the 15-year-old students were enrolled in vocational tracks, above the 8.8% in 2003. As shown in the figure below, there were some fluctuations in this percentage over time.



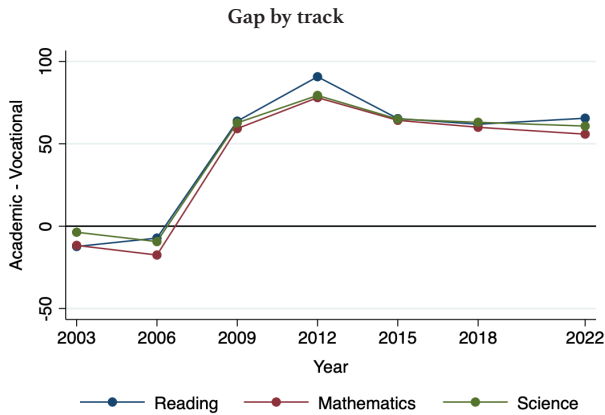
It is important to note that, because PISA only considers 15-year-olds, the percentage of students enrolled in vocational education for the whole population of students in Portugal, regardless of their ages, is different. In particular, many students who have repeated a grade decide to enrol in an upper-secondary vocational program, which is only available to them once they reach the age of 16. Those students are not included in the population studied by PISA. However, 15-year-old students that are still in lower-secondary education can be enrolled in the vocational courses that are offered at that level.

When we examine the average scores of the two groups of students who are enrolled in the academic or vocational track, we find large fluctuations in performance over time in all domains, as shown in the figures below. In these figures, the vocational track includes both lower and upper-secondary vocational courses.

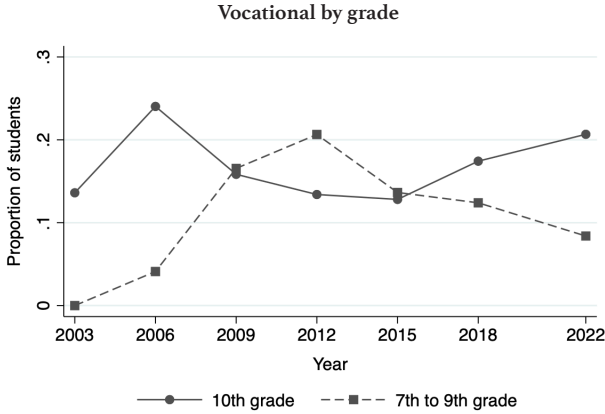




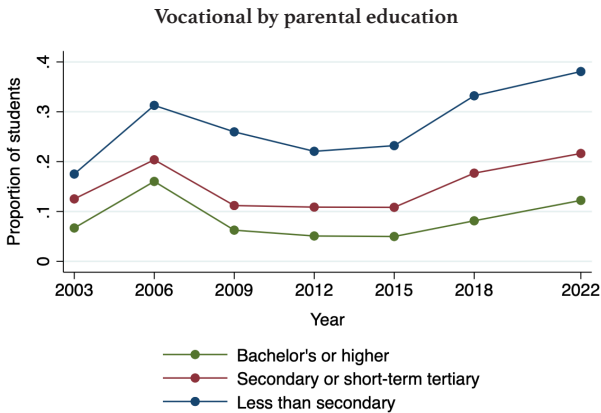
The next figure presents the evolution of the corresponding performance gaps between the two tracks. In 2009, the academic and vocational tracks diverge significantly, with the former having higher mean scores, as was already clear in the previous figures.



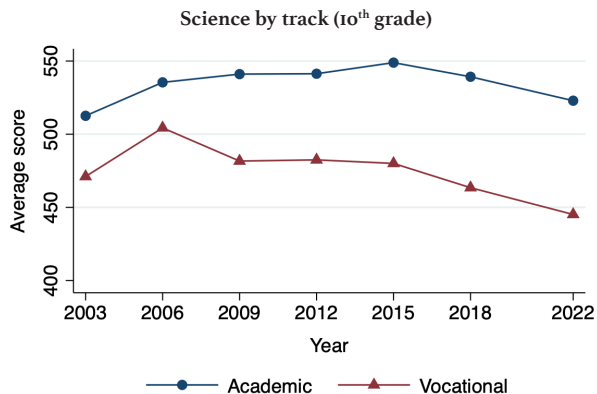
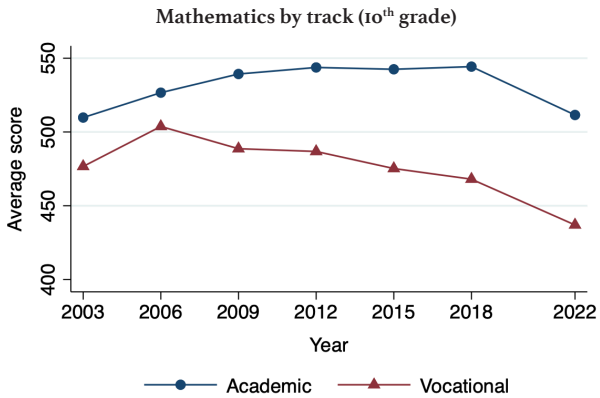
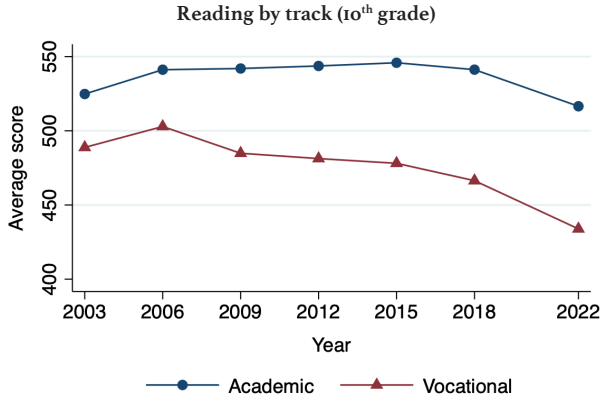
As shown in the following figure, 2009 also saw a significant rise in the proportion of 15-year-old students enrolled in lower-secondary vocational courses. This result suggests that the vocational track became more attractive for students with below-average performance. This is also related to the increase of the compulsory schooling leaving age that was put into effect that year. Later, in 2015, there is an expansion of the upper-secondary vocational track. These adjustments led to relevant changes in the characteristics of the students enrolled in vocational courses.



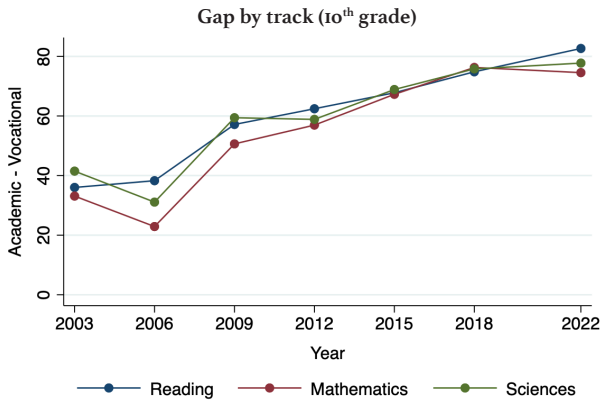
The figure below depicts the proportion of students following a vocational track for each of the following three groups: students who have at least one parent with a bachelor's degree or higher, students whose parents have at most a secondary or short-term tertiary degree, and students whose parents did not finish secondary education. It is clear that students with less qualified parents choose more often a vocational track. However, for all groups, the proportion of students in the vocational track has been increasing since 2018.



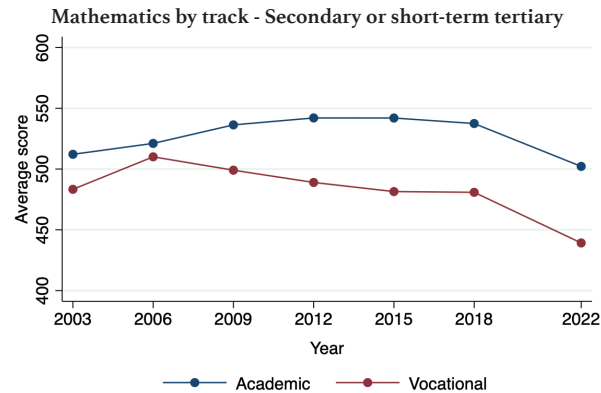
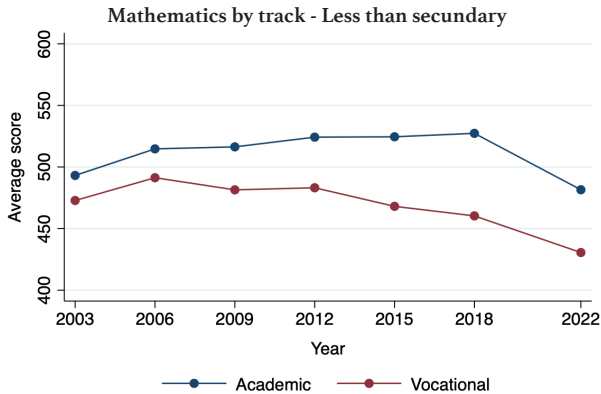
The general picture changes when we restrict our attention to the 10th grade, which is the modal grade for 15-year-olds. As shown in the figures below, students in the academic track perform better than those in the vocational track for the entire period. This happens across the three domains.



The next figure shows the corresponding gaps in performance between students in academic and vocational tracks. The gap is always positive, with a tendency to increase over time.



As is clear in the following figures, for the case of Mathematics, the widening gap between academic and vocational tracks remains even when comparing students with similar parental education.



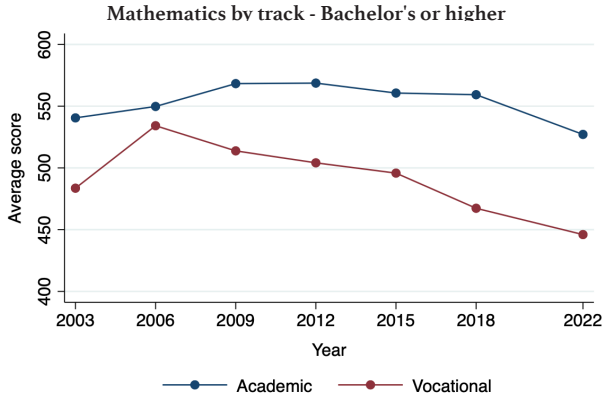
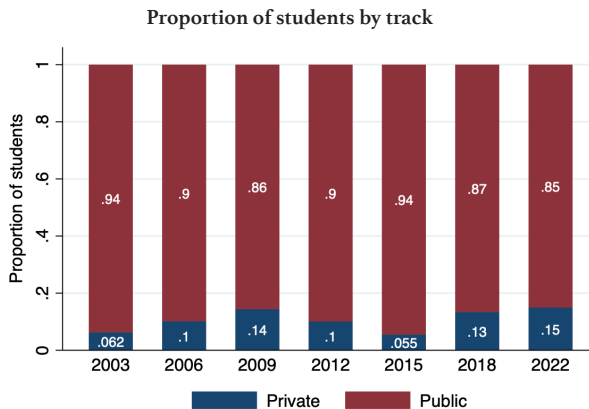


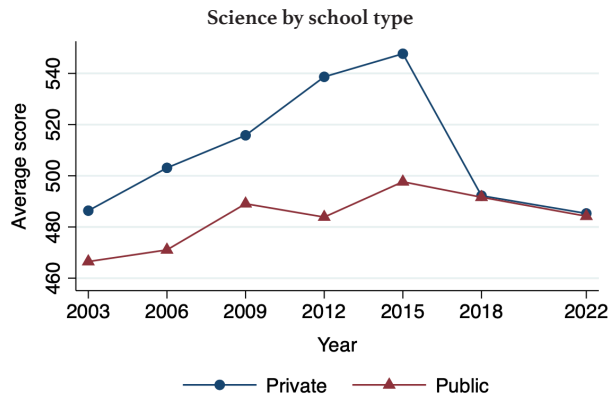
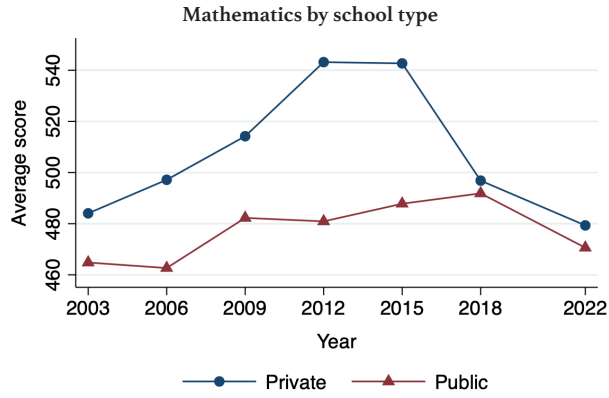
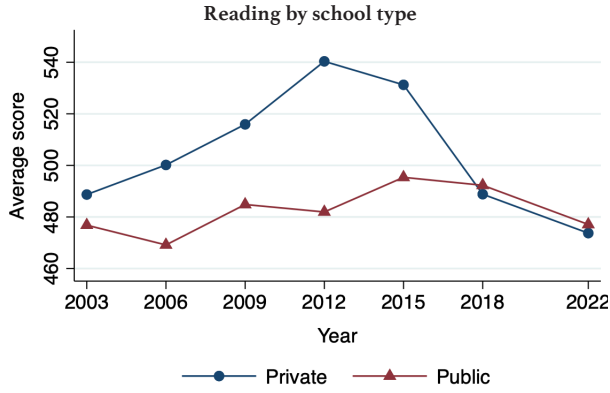
Figure Average scores in Mathematics by track (10th grade) by parental education

The gap between private and public schools

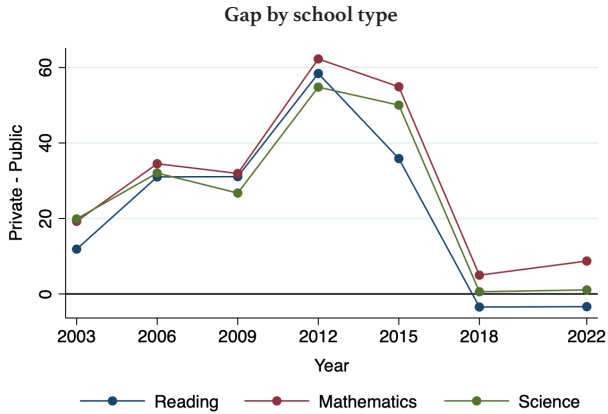
The proportion of 15-year-old students enrolled in private schools in Portugal is relatively small. In 2022, 15% of the students were enrolled in private schools. These included both government dependent and independent private schools. Still, as depicted in the next figure, there are some fluctuations over time.



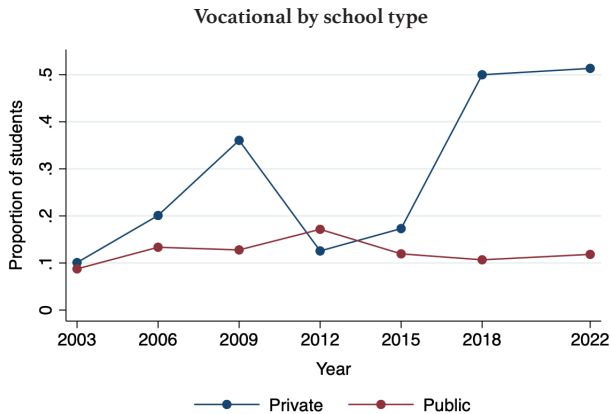
The following figures show that from 2018 onwards, the mean scores of public and private schools in the three domains converged, after diverging the most in 2012 and 2015.



The corresponding gaps in performance between students in private and public schools are presented in the figure below, confirming the patterns mentioned above.

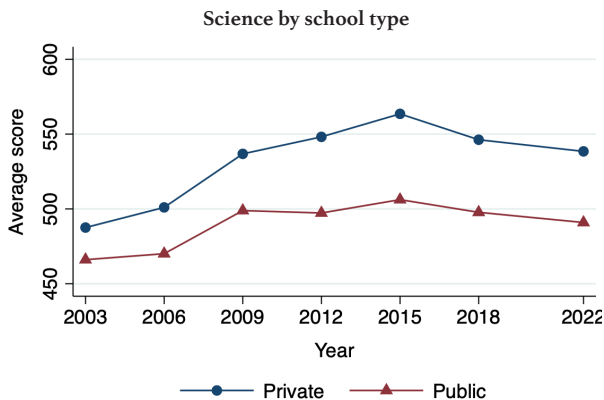
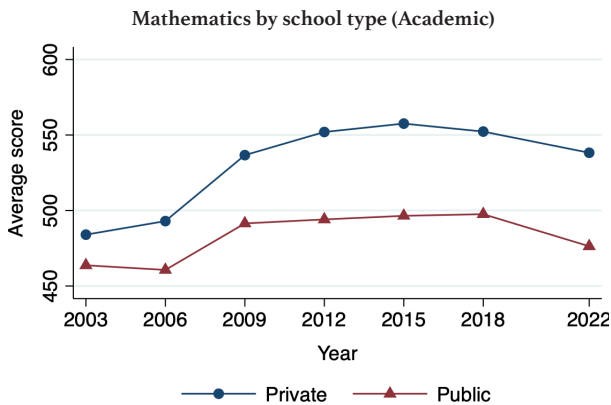
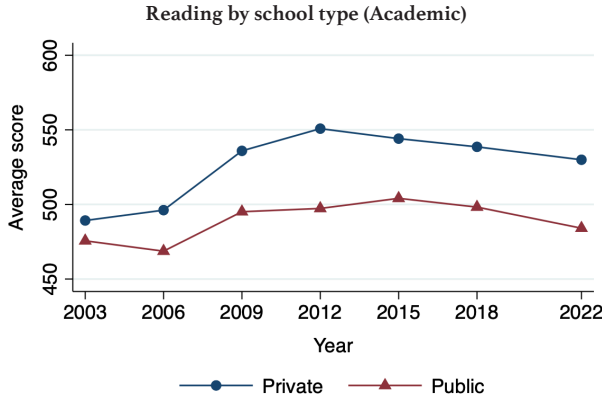


In the last two PISA assessments, 2018 and 2022, there is essentially no performance gap between students in private and public schools. The significant shift in the private school system's vocational course offerings that took place after 2015 may help to explain this pattern. This is clear in the following figure.

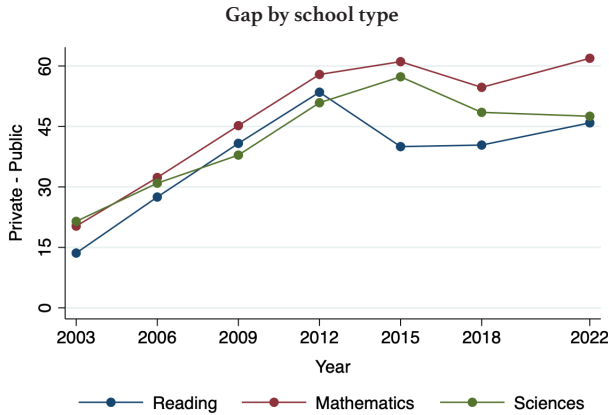


The percentage of students in private schools enrolled on the vocational track increased from less than 20% in 2012 and 2015 to slightly over 50% since 2018. Roughly half of all students enrolled in private schools were on the vocational track. This suggests, of course, that the profile of students attending private schools in the last two PISA assessments differs significantly from those of prior years.

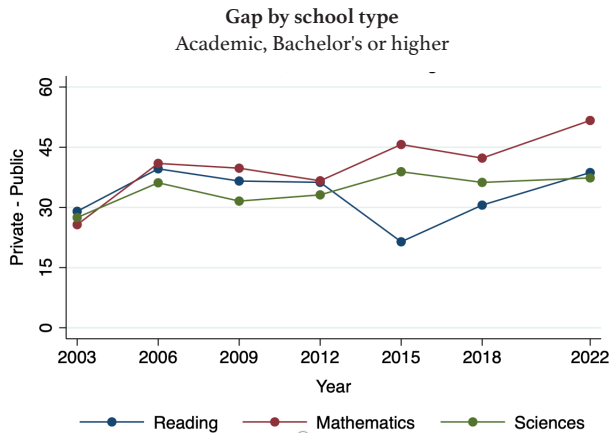
If we narrow our focus to just academic track students, we see a smoother evolution in their performance, with private schools average scores consistently above those of public schools. The following figures make this evident.



The figure below presents the corresponding gap in performance between the private and public schools. After increasing until 2012, the gap has remained relatively stable.



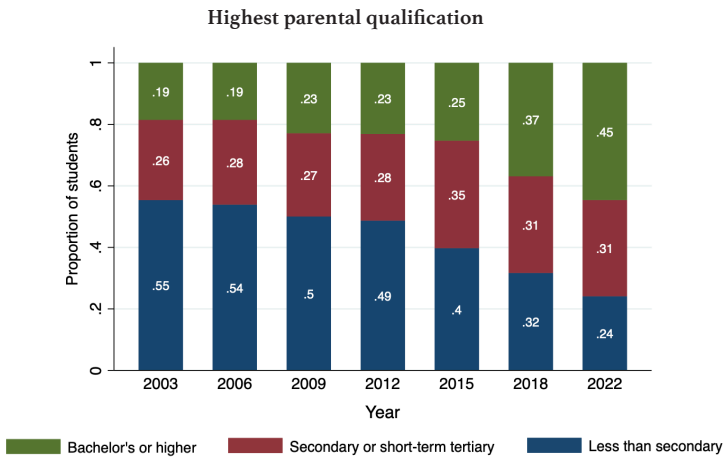
The average performance of students following an academic track in public and private schools differs, which may be related to differences in socioeconomic backgrounds and, in particular, to parental educational disparities. However, even when considering only students who have at least one parent with a bachelor's degree or higher, there is still a relevant gap in performance between private and public schools, in all domains, which suggests that there are other factors behind this difference.



Parental education

In 2003, the overall level of parental education among 15-year-old students in Portugal was low. More than half of the students' parents did not complete secondary school. The percentage of students who had at least one parent with a bachelor's degree was less than 20%. However, in the years that followed, things quickly began to change, with parental education levels increasing, particularly after 2015.

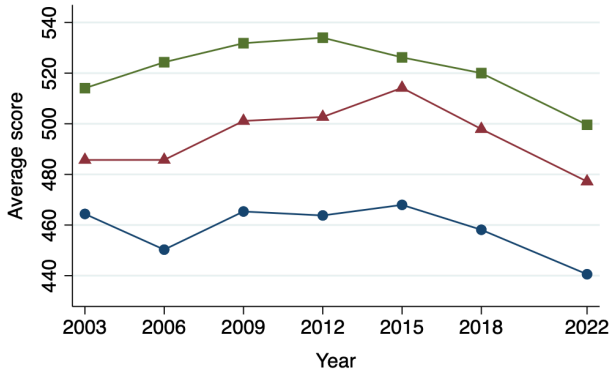
We divide the student population into three groups: (i) at least one parent with a bachelor's degree or higher, (ii) at least one parent with secondary education or a short-term tertiary degree, and (iii) neither parent having finished secondary education. The improvement in parental education is clear from the following figure.



In 2012, 49% of the students still had parents who had not completed secondary education. The percentage fell to 40% in 2015 and reached a little less than 25% in 2022. By 2022, 45% of students already had at least one parent with a bachelor's degree.

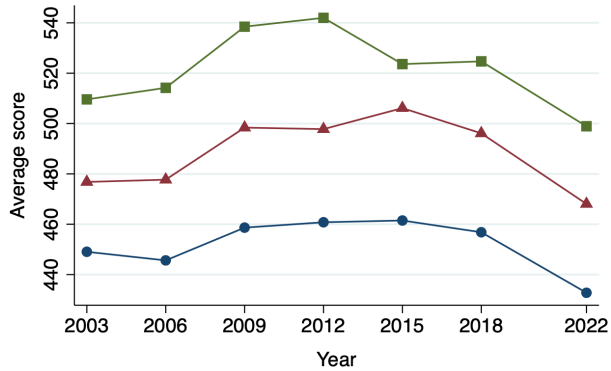
The average performance differences between students with varying parental education levels are depicted in the following figures. The average score of students whose parents are more qualified is higher. This is true for every PISA domain and the full time frame.

Reading by parental education



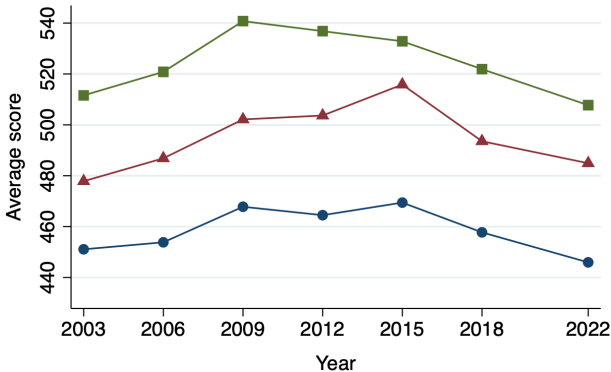
■ Bachelor's or higher ▲ Secondary or short-term tertiary ● Less than secondary

Mathematics by parental education



■ Bachelor's or higher ▲ Secondary or short-term tertiary ● Less than secondary

Science by parental education

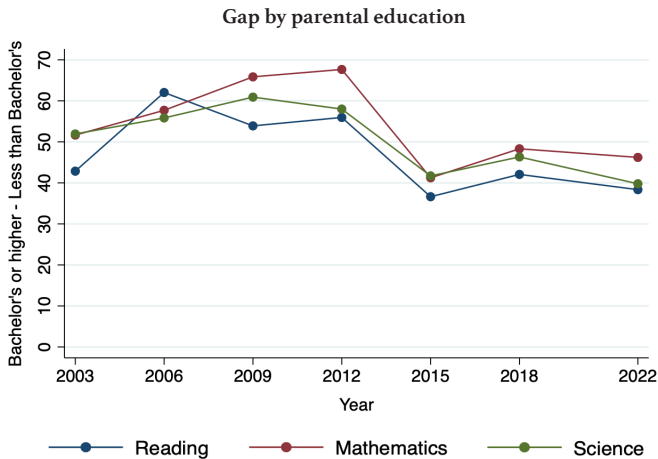


■ Bachelor's or higher ▲ Secondary or short-term tertiary ● Less than secondary

The period until 2009 is characterized by an overall increase in average performance for the three groups of students. In 2012, results do not change much. However, after that year, the trend starts to invert.

The assessment of 2015 marks the beginning of a reversion of the trend in Portugal. Since that year, there is a downward trend in the average performance among students with higher parental education. For the other two groups of students, the negative trend starts in 2018. All domains display this new, persistent trend of declining average performance, which continues until the last assessment in 2022.

The following figure shows the evolution of the gap in average performance for the three domains. It shows the difference in average scores between students with more educated parents (students who have at least one parent with a bachelor's degree or higher) and all other students.



The parental education performance gap is similar across PISA domains. Up until 2012, there was a slight increase in the gap. But then decreases in 2015. The drop in performance of students whose parents have a higher education level is the main cause of this year's decrease. Afterwards, there is a stabilization of the performance gap, indicating that the overall downward trend in student performance since 2018 has been comparable for students whose parents have higher and lower educational levels.

PISA trends in Portugal: The role of parental education

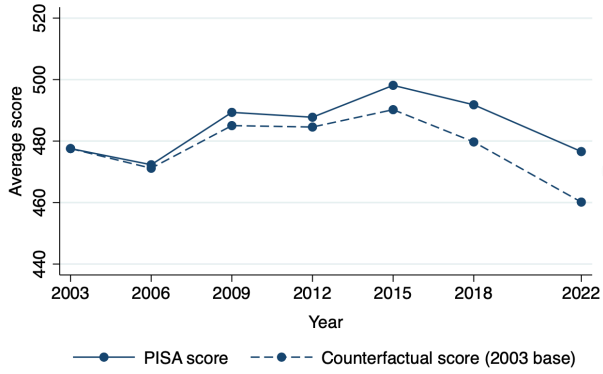
As shown above, students with higher parental education on average have higher scores in all PISA domains. Additionally, over time, the parents of the 15-year-old students being assessed in PISA have become more educated. Hence, it makes sense to ask the following questions: *How much of the evolution in the PISA scores can be attributed to the parents' higher educational attainment? And how much can be explained by the education system?*

The second question, about the role of the education system, is quite challenging. The education system is characterized by a plethora of different factors, from the organization of the system itself, school financing and management, curriculum, student evaluation, teachers, among many others. Over the period considered, a number of major educational policy reforms were also implemented. It is quite difficult to isolate all those factors and the effects of major policy reforms that affected all the education system, with cumulative impacts on students' learning, and at the same time to isolate other global factors such as financial crises or the pandemic.

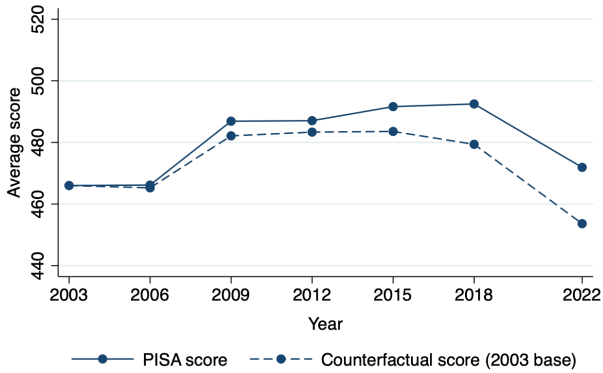
We address here the first question by carrying out the following counterfactual exercise: *Suppose the population of students according to their parental education was the same as in 2003, for all years. How would have the average scores evolved over time?* The idea of this exercise is to keep the influence of higher levels of parental education constant over time, so that fluctuations in the overall PISA scores calculated under that assumption have to be attributed to other factors. The various facets of the educational system are among those other factors, along with numerous others. Of course, those other factors will also include certain aspects of the students' socioeconomic background that are pertinent to their academic performance but are not captured by the parents' educational attainment.

The following figures present the evolution of the actual and the counterfactual average scores in the three domains. In each year, the counterfactual scores were calculated as weighted averages of the average scores of the three groups of students by parental education - (i) at least one parent with a bachelor's degree or higher, (ii) at least one parent with secondary education or a short-term tertiary degree, and (iii) neither parent having finished secondary education - using as weights their proportion in the population in 2003. We note that the actual PISA scores can be obtained by using as weights the actual proportions in each year.

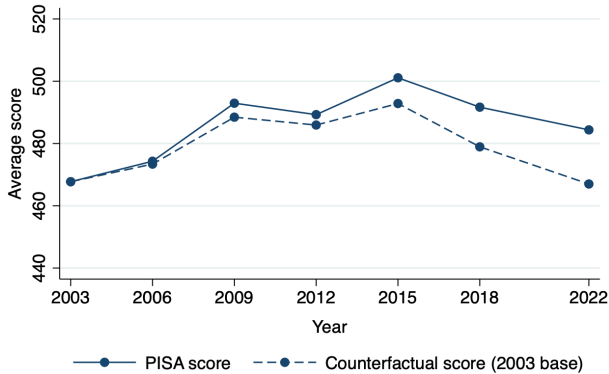
Counterfactual score - Reading



Counterfactual score - Mathematics



Counterfactual score - Science



Up until 2012, for all three domains, the counterfactual average scores are only slightly lower than the actual ones. This means that keeping the weights of the three groups of students according to their parental education fixed at the 2003 level, affects little of the evolution of the overall PISA scores. This is consistent with the observation that parental education levels rose more noticeably only after 2012. Thus, the evolution of scores up to that point was driven by improvements in student performance across all parental education levels, which persisted until 2009 and stabilized in 2012.

From 2015 onwards, the differences between the actual and the counterfactual scores widen, with the counterfactual PISA scores becoming increasingly lower than the actual PISA scores. The conclusion is that since 2015, the increasing levels of parental education are playing an important role in the evolution of the overall PISA scores in all domains.

In Mathematics, the average PISA scores increased until 2018. However, after disentangling the effects of the increasing parents education, in the counterfactual scenario, a different picture emerges. The large improvement until 2009, was driven by a generalized improvement in scores of all students regardless of their parents' education. That generalized improvement in scores ended in 2009. It was the increasing parents' qualifications that sustained the continued improvement in the following years. For Reading and Science, similar conclusions are obtained except that the generalized improvement in scores lasted longer, until 2015.

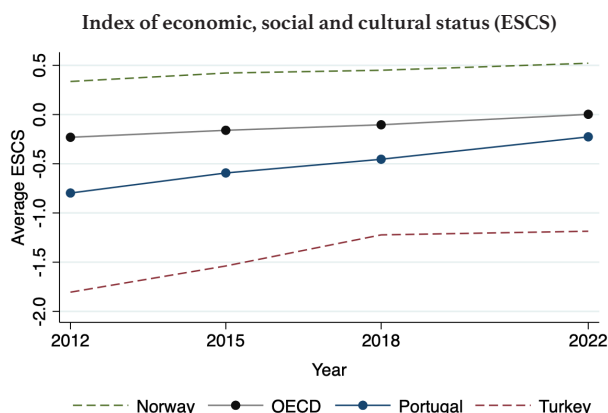
In 2018 there is a generalized deterioration of average scores for all levels of parental education. This occurs in all domains. The continued improvement in the parents' qualifications was sufficient to counteract the deterioration in Mathematics and maintain the increase in scores from previous years. But in Reading and Science it was not enough to compensate the deterioration in scores. In 2022, the continued improvement in the parents qualifications helped prevent an even larger drop in the average PISA scores across all domains.

Socioeconomic-based performance gaps in Portugal

Many studies have analysed the importance of children's socioeconomic background on their educational outcomes. For each PISA wave, the OECD has developed an index of economic, social and cultural status (ESCS). This index is calculated for each student and is based on three other indices constructed from the responses to the questionnaires applied during the PISA assessments in each year:

- Home possessions: How many or whether specific items are owned by a student's household (e.g. works of art, books, musical instruments, digital devices, bathrooms, own room, motor vehicles);
- Parental occupation: Open-ended questions about parents' occupation, converted into an index combining income and education to reflect the status of an occupation;
- Parental education: Median cumulative years of education associated with completion of the highest level of education attained by parents (i.e. Primary, Lower secondary, Upper secondary, Post-secondary non-tertiary, Short-cycle tertiary, Bachelor's, Master's, and Doctoral degrees).

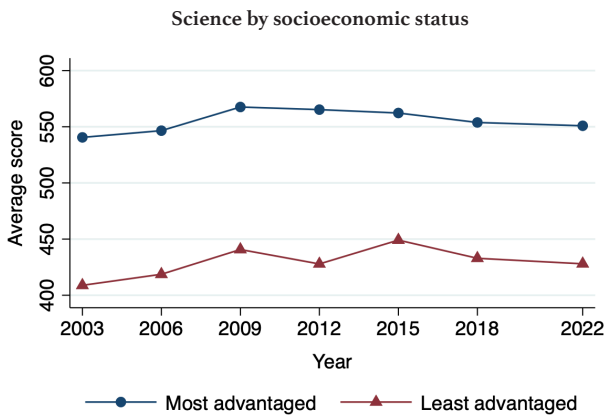
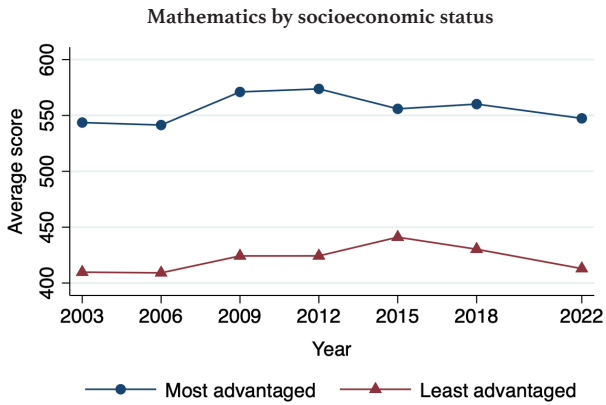
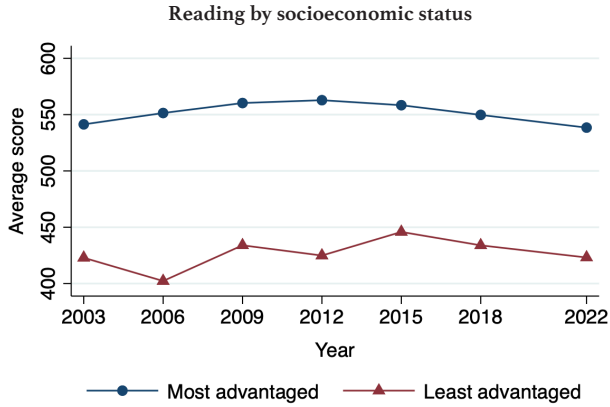
The mean of the ESCS index for students in Portugal is below the OECD average. However, as shown in the figure below, it has been converging over time.



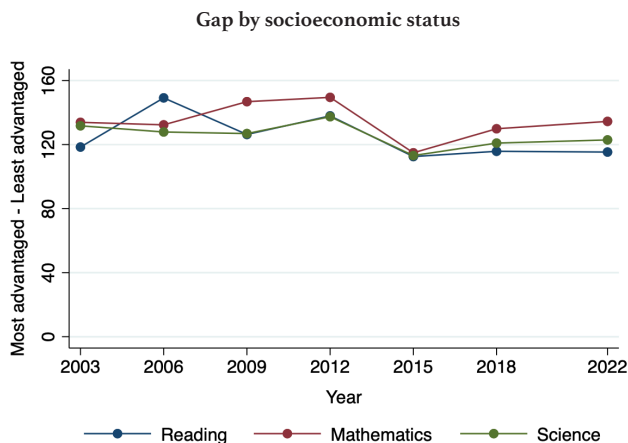
To better understand the range of variation of the ESCS index, we look at the most advantaged and the least advantaged students, defined as the students in the top and the bottom deciles of the ESCS distribution. The table below provides the percentage of students with some selected characteristics among students in these two groups in 2022 across all students in Portugal.

	Most advantaged (Top 10%)	Least advantaged (Bottom 10%)
Fewer than 26 books at home	1%	77%
More than 200 books at home	58%	1%
No musical instruments	5%	54%
No works of art	3%	54%
More than one room with a shower	96%	32%
Bachelor's or higher	Almost 100%	Almost 0%
9 th grade or lower	Almost 0%	Almost 100%

The following figures show the evolution of the average scores for the most advantaged and for the least advantaged students in Portugal. It is clear that there is a large and persistent gap over time.



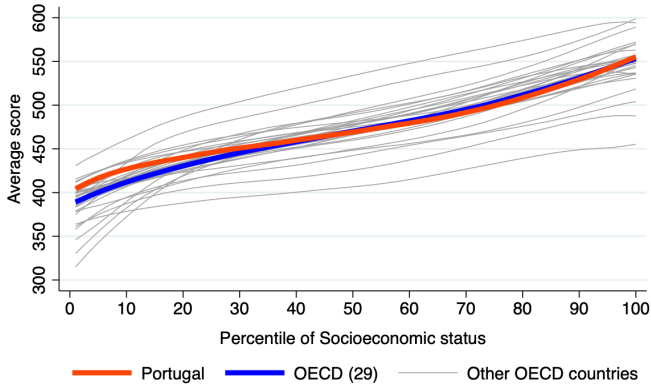
The figure below presents the corresponding gaps in performance between the most advantaged and the least advantaged students. The gaps are relatively stable over time. They increased slightly in Mathematics and Science in the last two cycles. However, they are still lower than in the period until 2012.



Socioeconomic-based performance gaps: Portugal and the OECD

In every country that participated in PISA, students from more favoured backgrounds have, on average, better performances. In this section, we explore this relation by comparing the performance of students with comparable socioeconomic conditions but studying in different countries. For the comparison, instead of using the values of the ESCS index, we use the corresponding international percentiles or deciles obtained from the distribution of ESCS values across all OECD students. The following figure represents the relation between performance and socioeconomic background by showing, for PISA 2022, the average score in Mathematics as a function of the international percentile of the ESCS index in each country. It displays the relation for Portugal, other countries in the OECD, and also the OECD average.

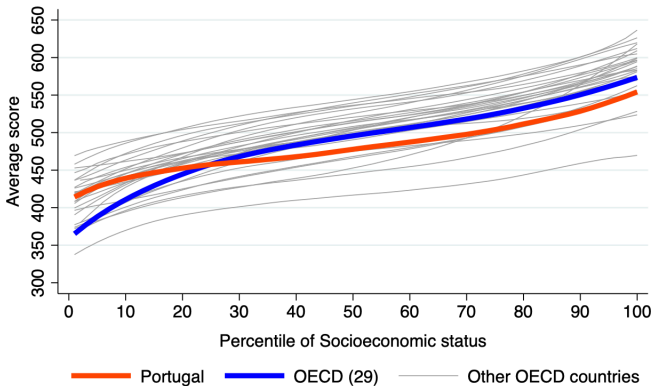
Performance and socioeconomic status
Mathematics - 2022



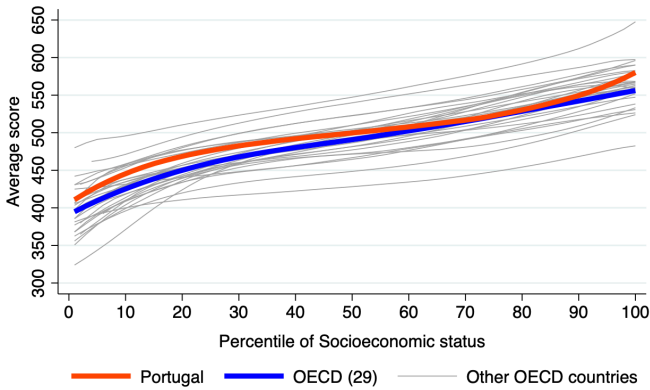
For the OECD, students in the 90th percentile of the ESCS index, on average, score around 530 points, while students in the 10th percentile of the socioeconomic distribution score around 410 points. Compared to the OECD, less advantaged students perform relatively better in Portugal. In fact, for the lowest percentiles, the average score of students in Portugal surpasses most of the other countries. For students in the top percentiles of the ESCS distribution, the performance in Portugal is very similar to the OECD average.

A similar analysis is done for other years. The figures below represent similar representations for 2003 and 2012.

Performance and socioeconomic status
Mathematics - 2003



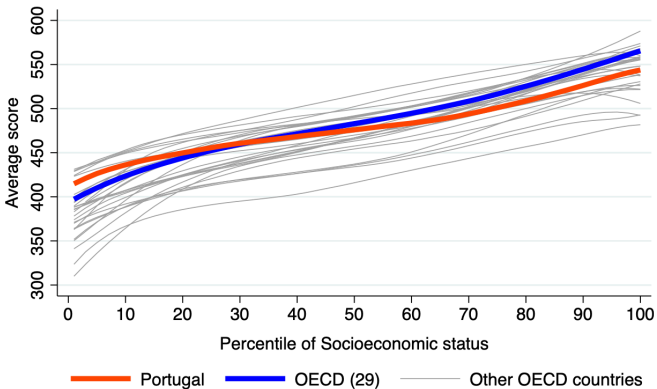
Performance and socioeconomic status Mathematics - 2012

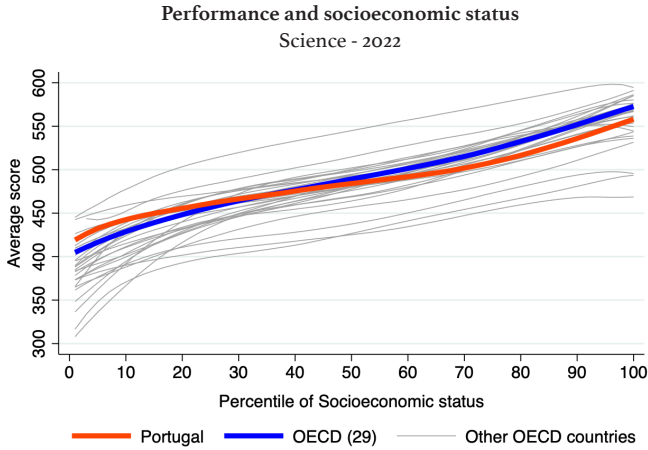


The better performance of the less advantaged students in Portugal was already evident since 2003. However, in that initial year, the performance of students above the 20th percentile was quite low compared to other countries. But in 2012, performance levels were already at or above the OECD average for all the ESCS percentiles.

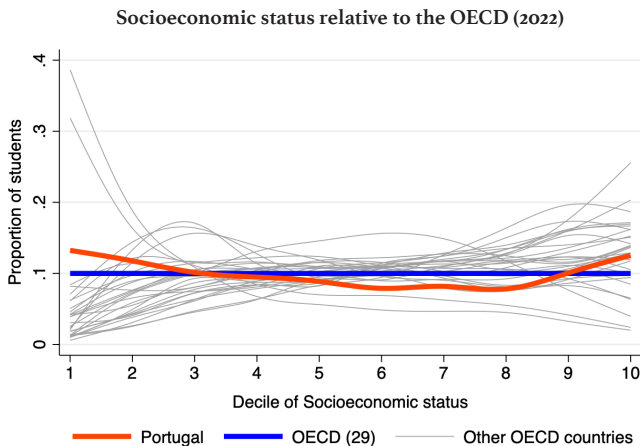
The figures below present the mean performance in Reading and Science of students in each international percentile of the ESCS distribution for different countries in 2022. Again, on average, less favoured students perform relatively well in Portugal compared to similar students in other countries. However, for these domains, the more favoured students - in the top half of the ESCS distribution – perform worse in Portugal relative to the OECD average.

Performance and socioeconomic status Reading - 2022



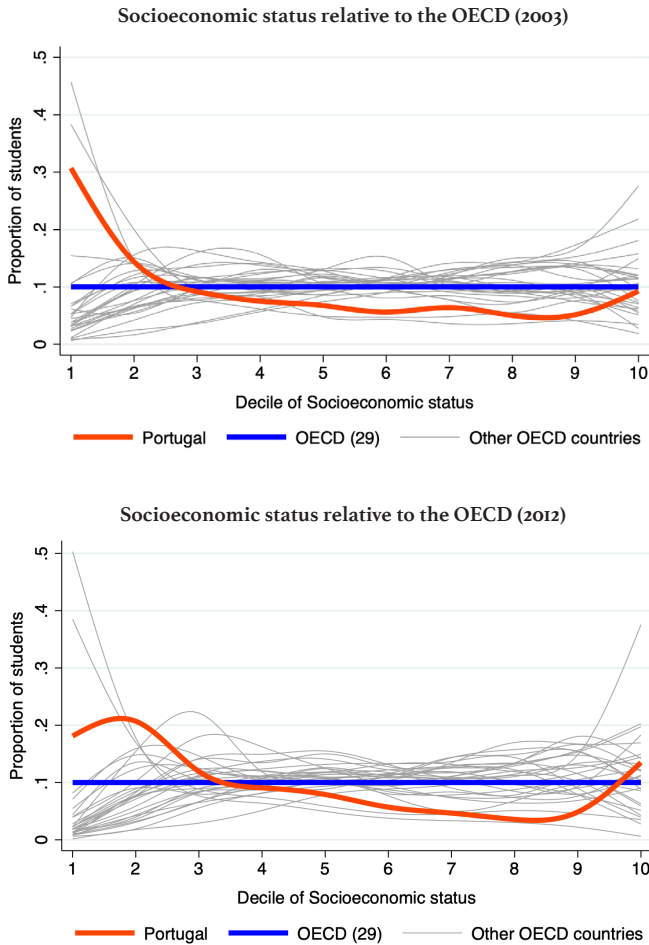


As shown above, in 2022, Portugal displays a performance in Mathematics that is either similar or above the OECD average for each percentile. Still, the average PISA score in Mathematics for Portugal is below the OECD average. This happens because, compared to other OECD countries, Portugal has a higher prevalence of less advantaged students. To better understand this, we can compare the distribution of students by socioeconomic status across countries. The next figure presents the proportion of students in each country in each decile of the international distribution of the ESCS index.



Portugal displays a large percentage of students in the bottom international decile of the ESCS distribution: 13% in Portugal, only surpassed by Turkey (39%) and Mexico (32%). The figure also reveals an unequal distribution, with larger prevalence of students in the lowest and highest deciles of the ESCS distribution.

The figures below present a similar analysis for 2003 and 2012. It is clear the larger prevalence of disadvantaged students in Portugal in those years compared to 2022.



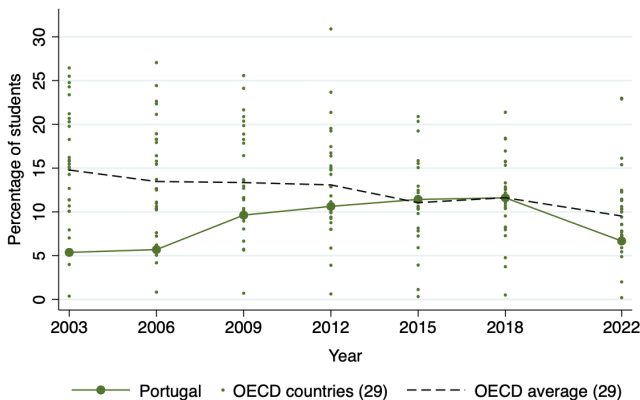
Top and low performing students

In order to characterize what students typically know and are capable of at a particular level, PISA scores are categorized according to proficiency levels. These are specific to each domain. We will focus on Mathematics since this was the major domain in the last PISA cycle. A condensed description of these Mathematics levels and the corresponding score intervals can be found in the table below. Students are considered top performing when they are at or above Level 5 in the proficiency scale, and low performing when they are below Level 2.

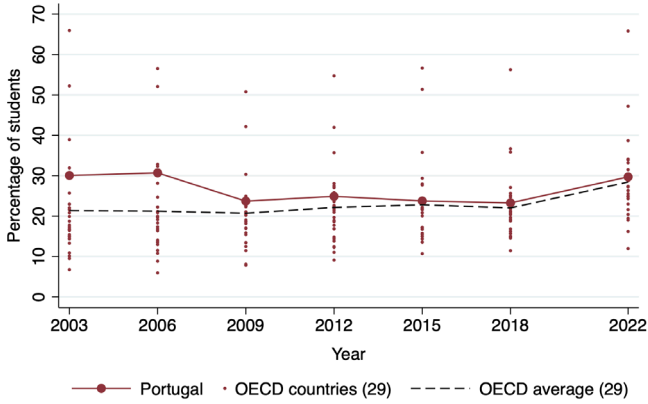
	Level	Score	A student at this level typically can...
Top performing students	6	[669.20,...]	...work through abstract problems and demonstrate creativity and flexible thinking to develop solutions.
	5	[669.99, 669.30]	...develop and work with models for complex situations, identifying or imposing constraints, and specifying assumptions.
	4	[544.68, 606.99]	...work effectively with explicit models for complex concrete situations.
	3	[482.38, 544.68]	...devise solution strategies, including strategies that require sequential decision-making or flexibility in understanding of familiar concepts.
	2	[420.07, 482.38]	...recognise situations where they need to design simple strategies to solve problems.
Low performing students	1a	[357.77, 420.07]	...answer questions involving simple contexts where all information needed is present, and the questions are clearly defined.
	1b	[295.47, 357.77]	...respond to questions involving easy to understand contexts where all information needed is clearly given in a simple representation.
	1c	[233.17, 295.47]	...respond to questions involving easy to understand contexts where all relevant information is clearly given in a simple, familiar format and defined in a very short, syntactically simple text.

In the figures below, we consider the case of Mathematics and plot the percentage of top and low performing students in Portugal, in other OECD countries (the dots), and the OECD average (dashed line). Up until 2015, the percentage of top performing students in Portugal converged to the OECD average; however, in 2022, it diverged. In 2022, 7% of the students in Portugal were top performers. This compares with 12% in 2018. Although the proportion of top performers decreased for the OECD average as well, the fall was steeper for Portugal.

Top performing students - Mathematics



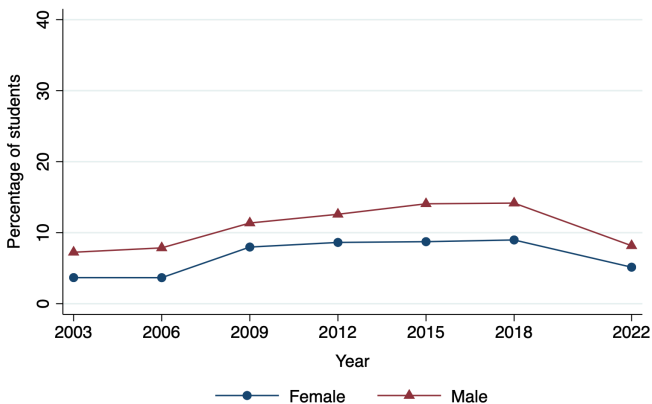
Low performing students - Mathematics



For the low performing students, we can see that this percentage also converged to the OECD average until 2015, but it did not diverge since then. However, as can be seen in the graph, the OECD average is pulled up mainly by two countries with particularly high percentage of low performing students (Mexico with 66% and Greece with 47%). Despite being very close to the average, Portugal ranked 22nd out of 29 countries (in other words, the percentage is higher than the median). In 2018, the percentage of low performing students was 23%, but in 2022 it increased to 30% - back at 2003 levels.

When we look at top and low performing students by gender in the figures below, we see that while there is a clear gap between the percentage of top performing boys and girls, the difference in the percentage of low performing students is not as clear, particularly since 2015. This suggests that the gap in average scores between girls and boys in Mathematics is more driven by the top performing students, than by the low performing students.

Top performing by gender - Mathematics

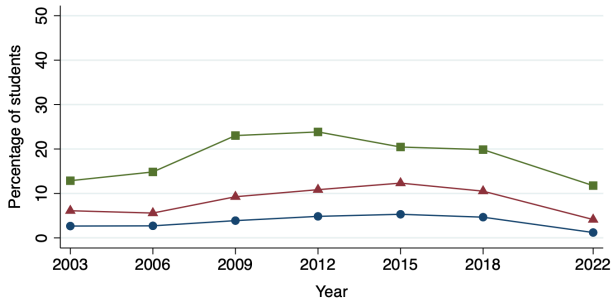


Low performing by gender - Mathematics



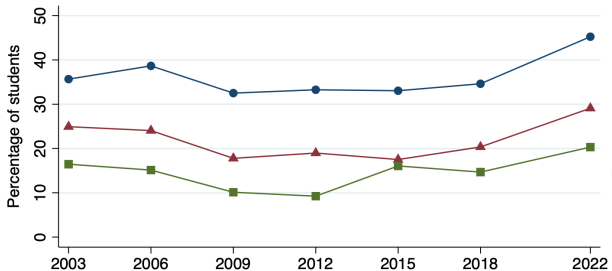
The patterns observed in the average scores are also evident when examining the percentages of high and low performing students by parental education. As can be checked in the figures below, the proportion of top-performing students increases with parental education, and the opposite is true for low-performing students.

Top performing by parental education - Mathematics



■ Bachelor's or higher ▲ Secondary or short-term tertiary ● Less than secondary

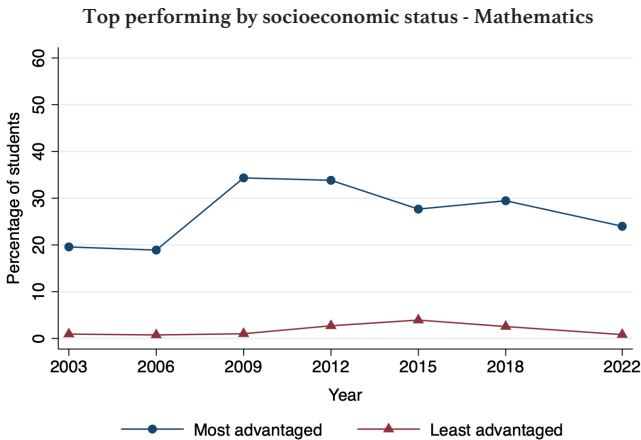
Low performing by parental education - Mathematics

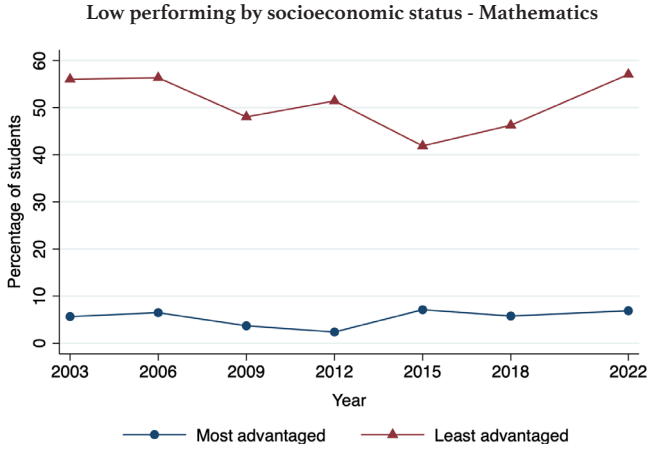


■ Bachelor's or higher ▲ Secondary or short-term tertiary ● Less than secondary

From 2009 to 2018, for the students with at least one college educated parent, the percentage of top performers was above the percentage of low performers – in contrast to the overall sample. However, this is no longer the case in 2022. When we focus on the evolution within each group, we see that it is relatively similar to the overall evolution. In particular, in 2022 all three groups had a decrease in the percentage of top performers and an increase in the percentage of low performers.

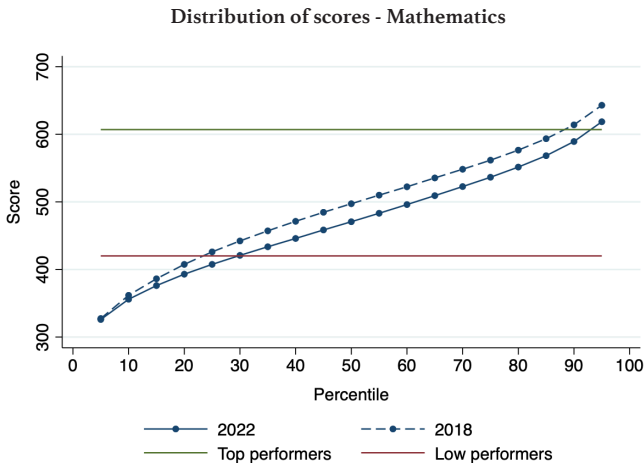
If we look at these percentages by the top and bottom deciles of socioeconomic status, shown in the figures below, we naturally find very large differences. Namely: there are less than 1% top performers among the least advantaged students in 2022, compared to about 57% low performers. Amongst the most advantaged, about 24% are top performers and 7% low performers. In terms of evolution when comparing with 2018, they go in the same direction as the overall sample: the percentage of low performing students increased in both groups, and the percentage of top performing students decrease in both as well. There has been a noticeable increase in the percentage of top-performing students in the most advantaged group in 2009; although this percentage has since decreased, it is still higher than in 2006. The differences between these two groups have remained significant throughout the entire period. Up until 2015, there was a decline in the percentage of low performers among the least advantaged students; however, after two PISA cycles, the percentage is now back to 2003 levels.



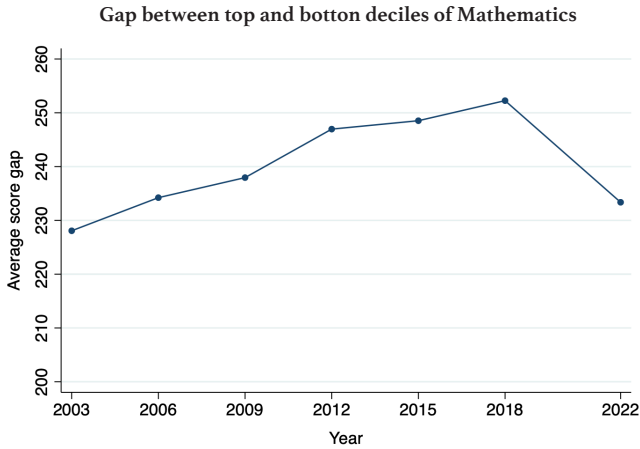


Distribution of scores

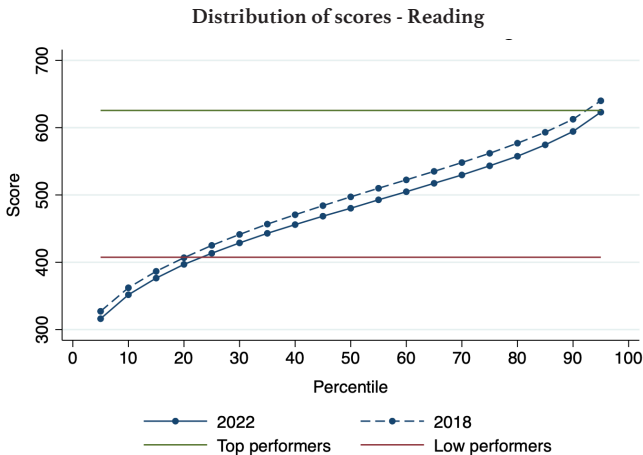
So far, we have been looking at mean scores. In this section, we focus on the distribution of scores. For each domain in each year, we ranked all students by score and then divided them into 20 equal groups, each representing 5% of the students. Next, we determined the cutoff points that separated these groups, yielding a total of 19 values. The threshold scores for Mathematics in PISA 2018 and 2022 are displayed in the figure below. As an example, the first dot in the solid line (2022) indicates that 5% of the students obtained a score of under 326. The last dot indicates that the students in the top 5% achieved a score above 619. This gives us an idea of the dispersion of the scores in each year. We also present the cutoff points for a student to be considered top or low performing (represented by the two horizontal lines). Here, as before, we can see that in 2022 about 30% of the students were low performing.

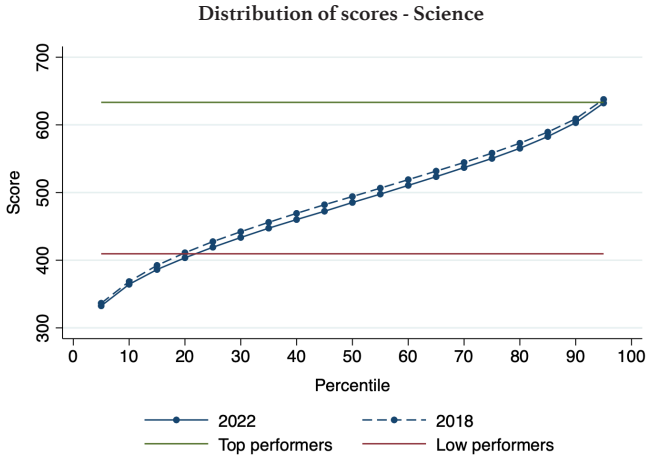


The nineteen cutoff points for 2018 appear in the dashed line in the figure. We can see that for 2022 the scores are lower at almost every point of the distribution, except for the bottom 10% for which there is no difference. This matches the decrease in the gap between the top and bottom 10% in this last cycle, as can be seen in the figure below.

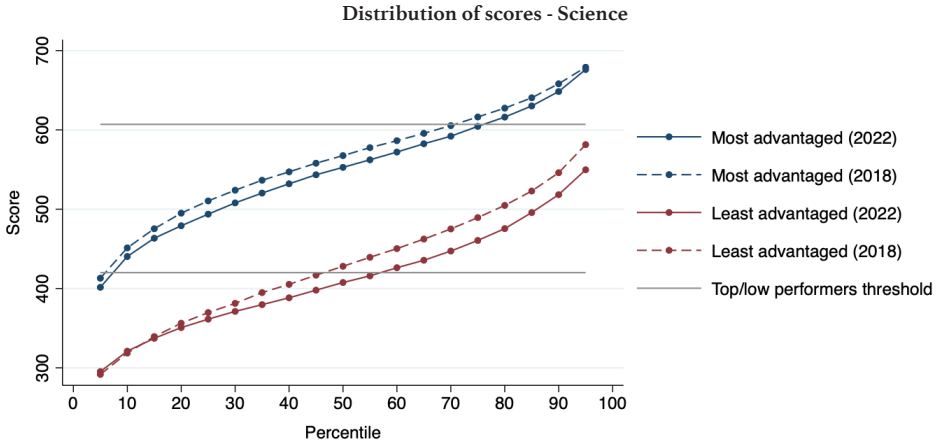


Although in 2022 there is a reduction in the dispersion of scores, this result from the larger decline in performance of the top performers. For Reading and Science, the figures below denote a similar evolution across the distribution – but the difference in the evolution of the best and worst performing students is less pronounced than in Mathematics.

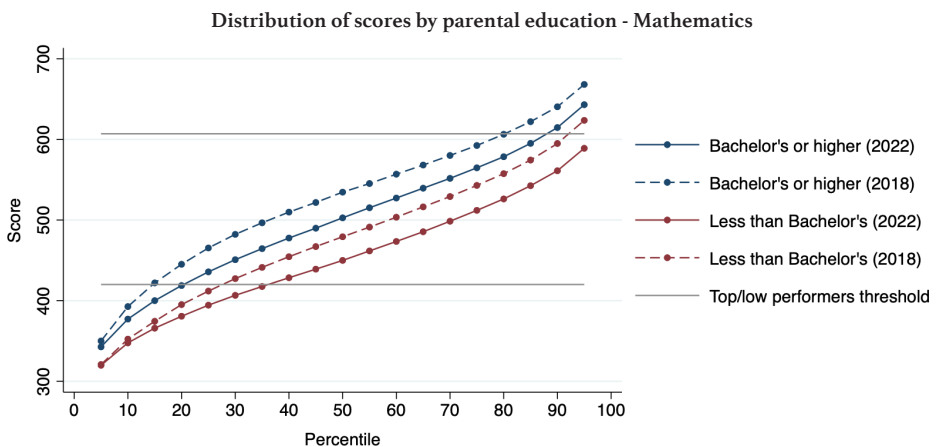




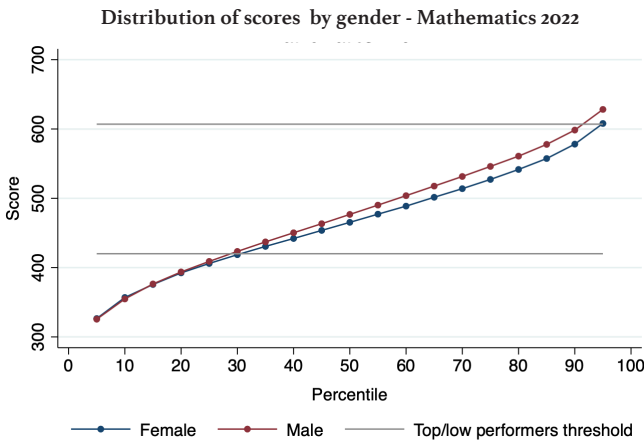
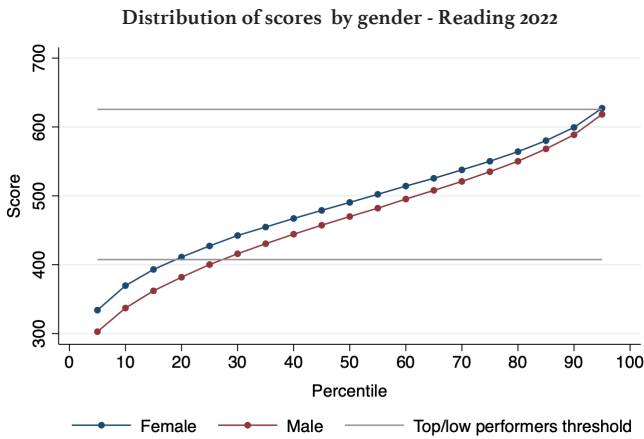
We also look at the distribution of scores by socioeconomic status. The figure below presents the distribution of scores for Mathematics in PISA 2018 and 2022. As before, the nineteen cutoff points for 2022 appear in the solid lines, whereas the 2018 appear in the dashed lines. The blue lines represent the scores of the most advantaged students, while the red ones the scores of the least advantaged students. As expected, the least advantaged students' scores are lower than those of the most advantaged students across the distribution. For the most advantaged students, the decrease in scores from 2018 to 2022 is reflected in most of the distribution, with the notable exception of the top 5%. As for the least advantaged, the decrease in scores happens along the distribution except for the bottom 15%. This means that the generalised fall in performance was not homogenous between socioeconomic groups. Specifically, the scores of the best performing students among the least advantaged fell, whereas this decline did not occur among the best performing of the most advantaged students. The slight increase in the gap between the average score in these two groups (as seen before) is partly driven by this. Finally, the two horizontal grey lines represent the thresholds for top/low performers. As shown before, there are practically no top performers among the least advantaged, and very few low performers among the most advantaged.

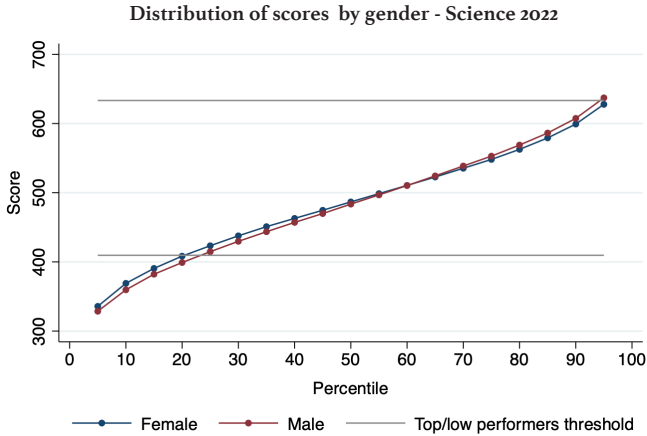


Next, we examine the distribution of the scores in Mathematics by parental education level. Results are presented in the figure below. The blue lines represent the scores of students who have at least one parent with a Bachelor's degree or higher, while the red lines represent the scores of students whose parents have less than a Bachelor's degree. As expected, the scores of students with more educated parents are higher across the distribution compared to those whose parents have less education. The gap is narrower for the worst performing students than for the best performing students. As before, the solid lines show scores from 2022, whereas the dashed lines show scores from 2018. For both groups of students, the decrease in scores in 2022 is reflected in most of the distribution, except for the worst performing students. However, this difference is more pronounced for the students with less educated parents. Finally, the grey lines represent the thresholds for top/low performers, where we can see the increase in low performing students and decrease in top performing students for both groups.



If we look at the distribution by gender, focusing solely on 2022, we also obtain interesting results. Results are presented in the figure below. We have seen before that on average boys overperform girls in Mathematics. But for the bottom 25% there is virtually no difference: the distributions overlap. For Reading, girls overperform boys on average, although the difference is less pronounced as we move up in the distribution of scores - and at the top 5% of the distribution there is almost no difference between boys and girls. Finally, for Science, we saw that the average scores are very similar for boys and girls. This is reflected in the distributions as well, as they nearly overlap, although the curve is steeper for boys, meaning a slightly more dispersion in their scores (a similar pattern arises in Reading and Mathematics).

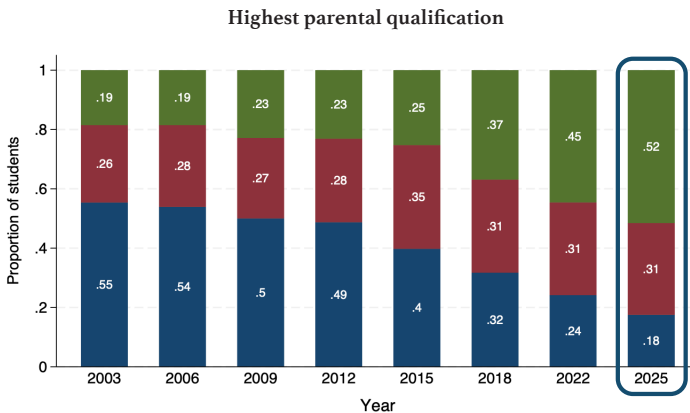




Outlook for Portugal in PISA 2025

This section presents an outlook for Portugal's performance in the upcoming PISA 2025. We consider the case of Mathematics. To make future projections, we define scenarios about how main drivers of student performance will change over time. These are based on the trends observed until the last PISA assessment in 2022. This exercise, despite its great degree of uncertainty, is helpful in that it gives an idea of the level of uncertainty surrounding the future performance of students in Portugal.

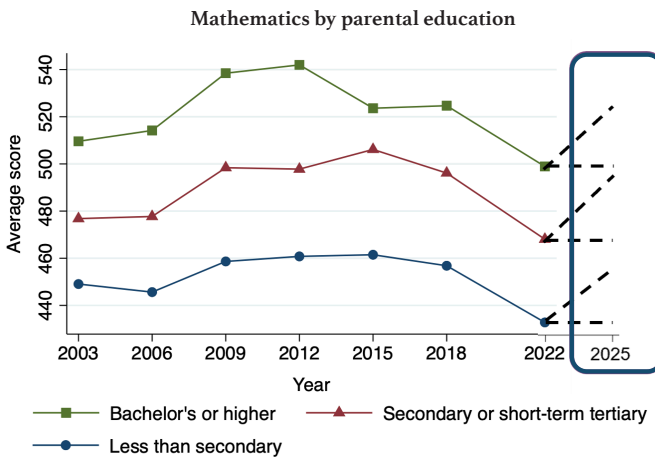
The main driver of student performance considered is the level of parental education. It is assumed a continued trend of improved parental qualifications for the new 15-year-old generation that will be assessed by PISA in 2025. The scenario for the distribution of students by parental education level in 2025 is shown in the figure below.



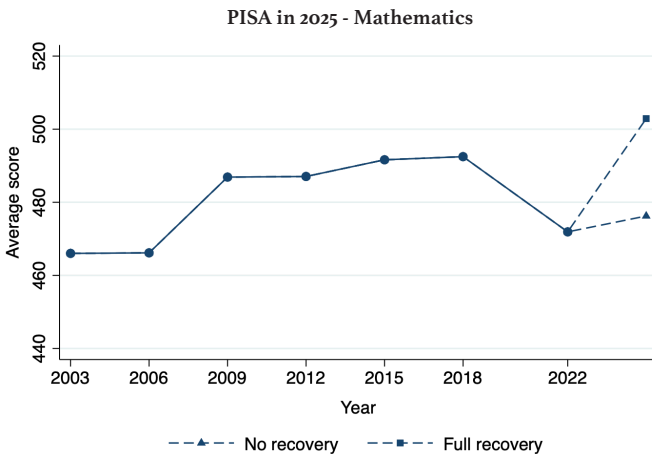
The other component behind this outlook exercise is the evolution of students' performance for each level of parental education. Students aged 15 years old in 2025 were enrolled in primary school, in the 4th or 5th grade, during the first lockdown in 2020. Therefore, these students were affected during an early stage of their schooling path. Unfortunately, there is very scarce evidence about learning losses and recovery of this cohort of students. Two scenarios are considered:

- No Recovery: student performance, conditional on the level of parental education, is the same as for the cohort of students that was assessed by PISA in 2022.
- Full Recovery: student performance, conditional on the level of parental education, is the same as for the cohort of students that was assessed by PISA in 2018.

The figure below presents these two scenarios.



Finally, the resulting predictions for the average score in Mathematics in PISA 2025 are presented in the figure below.



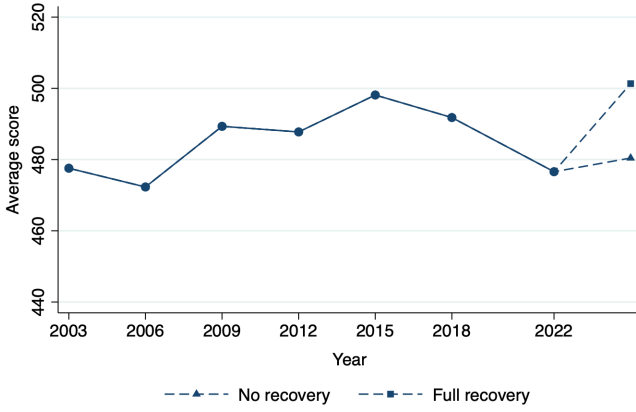
For both scenarios, there is an improvement in 2025 relative to 2022. This is a result of the higher qualifications of the parents of the new 15-year-old cohort. However, if there is only a partial recovery of the learning losses from the pandemic, the actual score in 2025 will likely lie somewhere in between the projections for the two scenarios.

Of course, it is also possible that the PISA 2025 cohort faced more learning losses which have not yet been recovered, and in such case, the outcome will be even worse than predicted in the “No recovery” scenario. Even before the pandemic, there were signs of a decline in performance of students from all backgrounds. Therefore, an additional source of uncertainty is whether the generalized deterioration in scores that started in 2018, before the pandemic, which is not included in the two scenarios considered above, will persist into 2025. Depending on the strength of these additional negative factors, the mean score in PISA 2025 could even go below the 2022 level.

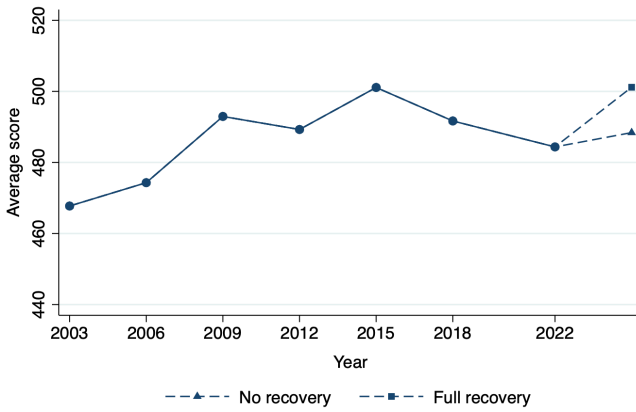
As the exercise presented above shows, the outlook for the future is very uncertain given the lack of knowledge about whether students are recovering, or not, their learning losses. A relevant source of information about the evolution of students’ learning is a study of the recovery plan that was implemented by the Portuguese government. The study was carried out by Instituto de Avaliação Educativa (IAVE) between January 10th and February 8th, 2023. It was a follow-up diagnostic study of a previous study, first carried out in 2021. The resulting report, “Estudo Diagnóstico das Aprendizagens 2023, Volume I – Apresentação de Resultados”, presents the findings of the evaluation of the Reading, Mathematics, and Science competencies of students in grades 3, 6, and 9. The items and tasks of the 2021 assessment were not made public and were used again in the 2023 edition with limited changes. Regarding mathematics, the findings show that there hasn't been any improvement in learning losses since 2021 for the students who were in grades 6 and 9 in 2023. Although there is no overlap between these cohorts and the cohort of students that will take PISA in 2025 (which, in 2023, were in grades 7 and 8), the overall results of that study appear to be more aligned with our “No recovery” scenario.

The following figures present the results of a similar exercise assuming the same two scenarios for the other two domains, Reading and Science. As in the case of Mathematics, the exercise reveals a large degree of uncertainty about what will be the evolution of the overall PISA scores.

Pisa in 2025 - Reading



Pisa in 2025 - Science



CONCLUSIONS

Portugal has been a participating country in PISA since its first edition in 2000. When the results from the first PISA assessment were published, Portugal was among the worst performing countries. In the following years, the country had a remarkable improvement in its PISA results reaching the OECD average in 2015, maintaining its relative position in 2018.

The growth in the initial PISA cycles occurred across all domains - Reading, Mathematics, and Science - and was driven by improvements in student performance across all parental education levels, which persisted until 2009 and stabilized in 2012. This evolution points to the ability of the education system to improve students' results regardless of their background.

The rise in parents' educational attainment, particularly after 2015, emerges as a major driving force behind Portugal's PISA score progression. Moreover, it appears to contribute to counteract a reversion of the previous trend of improving performance.

In 2015, the average performance of students whose parents have a university degree begins to decline. For the other students, the downward trend begins in 2018. The continued improvement in the parents' qualifications counteracted that downward trend and helped maintain the increase in the Mathematics PISA scores until 2018. In Reading and Science, the average PISA scores fell in 2018 as the improvement in the parents qualifications was not strong enough to compensate for the downward trend in performance.

Then, in 2022, the first PISA after the pandemic, there is a generalized fall in the results across the all the main domains, a fall that is larger than the OECD average.

The gap between students from highest and lowest socioeconomic backgrounds have remained relatively constant across time. Nonetheless, students from low socioeconomic backgrounds perform better in Portugal than students with similar conditions in other countries. These students represent a relevant share of the 15-years-old population in Portugal, which limits the ability of the country to achieve better overall results.

In PISA 2022, the largest reductions in PISA scores are concentrated in the average and top performers. The worst performers remained with similar results, which explains the fall in results' inequality in that cycle. Additionally, the fall between 2018 and 2022 was not uniform across socioeconomic groups. Specifically, the best performing of the least advantaged fell, whereas this decline did not occur among the best performing of the most advantaged.

The outlook for the near future, and for the results of Portugal in PISA 2025, is very uncertain. The higher qualifications of the parents of the new 15-year-old cohort will continue to be a positive factor. However, there is a large amount of uncertainty and lack of information about the extent to which learning losses in Portugal are being recovered or not.

It is likely that the pandemic effects will still be present in PISA 2025 results given the cumulative nature of the education process. Thus, to guarantee the recovery to past result levels it is relevant to improve the current framework of standardized testing and regular assessment and to follow evidence-based policies to differentiate between effective and non-effective education programs.

REFERENCES

- Anders, J., Has, S., Jerrim, J., Shure, N., & Zieger, L. (2020). Is Canada really an education superpower? The impact of non-participation on results from PISA 2015. *Educational Assessment, Evaluation and Accountability*. <https://doi.org/10.1007/s11092-020-09329-5>
- Testing. *Journal of Human Resources*.
- Carneiro, P. (2008). Equality of opportunity and educational achievement in Portugal. *Portuguese Economic Journal*, 7, 17-41.
- Cordero, J. M., Cristóbal, V., & Santín, D. (2018). Causal inference on education policies: a survey of empirical studies using PISA, TIMSS and PIRLS. *Journal of Economic Surveys*, 32(3). <https://doi.org/10.1111/joes.12217>
- Crato, N. (2020). Curriculum and educational reforms in Portugal: An analysis on why and how students' knowledge and skills improved. In *Audacious Education Purposes: How Governments Transform the Goals of Education Systems*. https://doi.org/10.1007/978-3-030-41882-3_8
- Durrant, G. B., & Schnepf, S. V. (2018). Which schools and pupils respond to educational achievement surveys?: a focus on the English Programme for International Student Assessment sample. *Journal of the Royal Statistical Society. Series A: Statistics in Society*, 181(4). <https://doi.org/10.1111/rssa.12337>
- Freitas, P., Nunes, L. C., Balcão Reis, A., Seabra, C., & Ferro, A. (2016). Correcting for sample problems in PISA and the improvement in Portuguese students' performance. *Assessment in Education: Principles, Policy and Practice*, 23(4), 456-472. <https://doi.org/10.1080/0969594X.2015.1105784>
- Hanushek, E. A., Link, S., & Woessmann, L. (2013). Does school autonomy make sense everywhere? Panel estimates from PISA. *Journal of Development Economics*, 104. <https://doi.org/10.1016/j.jdeveco.2012.08.002>
- Hanushek, E. A., Ruhose, J., & Woessmann, L. (2017). Knowledge capital and aggregate income differences: Development accounting for US States. *American Economic Journal: Macroeconomics*, 9(4). <https://doi.org/10.1257/mac.20160255>
- Hopfenbeck, T. N., & Görgen, K. (2017). The politics of PISA: The media, policy and public responses in Norway and England. *European Journal of Education*, 52(2), 192-205. <https://doi.org/10.1111/ejed.12219>
- Jerrim, J. (2013). The reliability of trends over time in international education test scores: Is the performance of England's secondary school pupils really in relative decline? *Journal of Social Policy*, 42(2). <https://doi.org/10.1017/S0047279412000827>
- Lavy, V. (2015). Do Differences in Schools' Instruction Time Explain International Achievement Gaps? Evidence from Developed and Developing Countries. *Economic Journal*, 125(588), F397-F424. <https://doi.org/10.1111/econj.12233>
- Marôco, J. (2020a). International large-scale assessments: Trends and effects on the Portuguese public education system. In *Monitoring Student Achievement in the 21st Century: European Policy Perspectives and Assessment Strategies*. https://doi.org/10.1007/978-3-030-38969-7_17

Marôco, J. (2020b). Portugal: The PISA effects on education. In *Improving a Country's Education: PISA 2018 Results in 10 Countries*. https://doi.org/10.1007/978-3-030-59031-4_8

Marôco, João & Lourenço, Vanda (2017). *Search of concurrent validity of large-scale international students assessments (LSISA) and high-stakes national exams: the portuguese case study*.

OECD (2001), *Knowledge and Skills for Life: First Results from PISA 2000, PISA, OECD Publishing, Paris*.

OECD (2023). *PISA 2022 Results (Volume I): The State of Learning and Equity in Education, PISA, OECD Publishing, Paris*.

OECD (2024), *PISA 2022 Technical Report, PISA, OECD Publishing, Paris*.

O'Leary, M. (2001). The effects of age-based and grade-based sampling on the relative standing of countries in international comparative studies of student achievement. *British Educational Research Journal*, 27(2). <https://doi.org/10.1080/01411920120037135>

Pereira, M. C. (2011). An analysis of Portuguese students' performance in the OECD programme for international student assesment (PISA). *Banco de Portugal, Economics and Research Department Economic Bulletin*.

Reis, H., Sazedj, S., & Wemans, L. (2024). Evidence from PISA on the skills of Portuguese students. *Banco de Portugal, Economics Bulletin, March 2024*.

Vandenbergh, V., & Robin, S. (2004). Evaluating the effectiveness of private education across countries: A comparison of methods. *Labour Economics*, 11(4). <https://doi.org/10.1016/j.labeco.2004.02.007>

Woessmann, L. (2016). The importance of school systems: Evidence from international differences in student achievement. *Journal of Economic Perspectives*, 30(3). <https://doi.org/10.1257/jep.30.3.3>